

*The projection of water demand through 2050 provides annual supply targets that must be met in future years. Tucson Water will ensure that sufficient water resources will be available to meet the supply needs of the community.*

## **CHAPTER THREE**

### **PROJECTIONS OF POPULATION AND WATER DEMAND**

The population in the Tucson area has increased over time, creating a growing need for water. Tucson Water used the most current population counts and projections available to plan for future water demand. These projections were developed from information provided by the U.S. Census Bureau, the Arizona Department of Economic Security, and the Pima Association of Governments (PAG) in order to maintain consistency with other regional-planning entities. The population projections were used with planning assumptions to estimate total water demand for Tucson Water's service area through 2050. These water demand projections are developed to ensure that adequate water supplies will be available to meet the needs of the community during the 50-year planning period and to identify the water-resource opportunities and challenges that lie ahead.

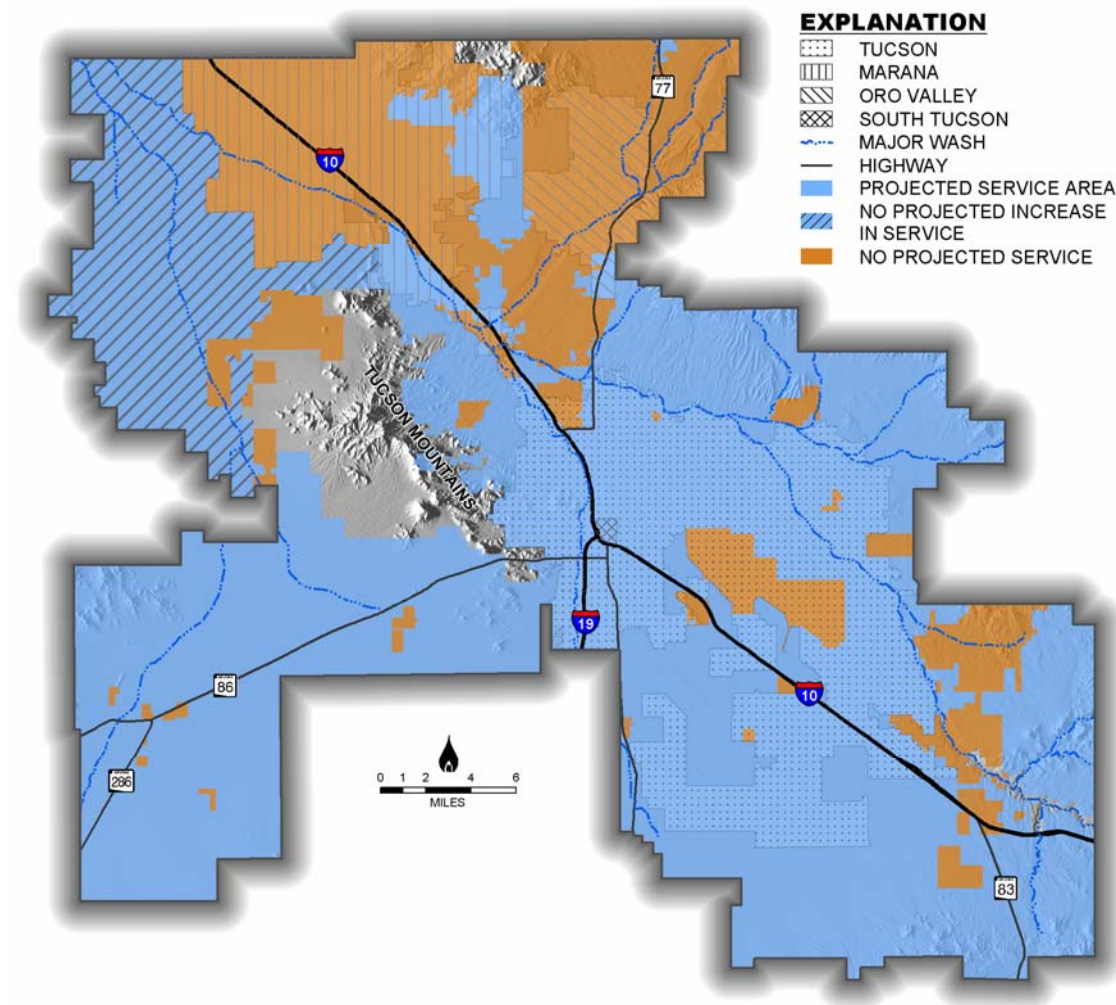
#### **LONG-RANGE PLANNING AREA**

The Long-Range Planning Area, shown on Figure 3-1, defines the maximum area within which Tucson Water could provide direct or indirect water service. Direct service will be provided to customers located within Tucson Water's projected service area (defined below). Indirect service means providing some level of support to other local water providers. The Long-Range Planning Area is largely consistent with the planning area described in *Tucson Water Resources Plan 1990-2100*.

In order to determine how much water must be provided in future years, it is necessary to define the geographic extent of Tucson Water's potential service area. About 60 percent of Tucson Water's residential, commercial, and industrial customers are currently within the City of Tucson's jurisdictional boundary with the balance located outside of the City.

Many other water providers have service areas contained within the Long-Range Planning Area. Tucson Water is not planning on providing direct service to these areas. These other service areas are generally located within the boundaries of the Town of Marana, the Town of Oro Valley, the Metropolitan Domestic Water Improvement District, the Flowing Wells

Irrigation District, and Davis-Monthan Air Force Base. The areas shown in brown on Figure 3-1 contain these other service areas along with all the other areas within which Tucson Water is not planning to provide direct service (see Appendix A: *Other Water Users in the Region*). All water providers located within the Long-Range Planning Area are dependent upon ground water to meet demand. This common resource must be managed from a regional perspective to ensure that it remains sustainable as a shared source of supply. Tucson Water needs to be aware of the ground-water utilization plans of other local water providers to meet their growing populations.



**Figure 3-1:** Long-Range Planning Area.

The populations served by these other water providers were excluded from Tucson Water's resource planning process. However, as the communities served by these providers grow in future years, additional water resources will need to be identified to meet their increasing demands. To provide a more regional perspective, this planning assessment includes population projections through 2050 for all of Pima County, the Long-Range Planning Area, and Tucson Water's projected service area. The projected service area is shown in blue on Figure 3-1. The crosshatched blue area is considered unlikely to require additional Tucson Water service in the future. Nonetheless, this area in Avra Valley is vital to the Utility since it includes City-owned lands that can be used to manage the City's renewable water supplies.

## PROJECTIONS OF POPULATION

Data sets provided by federal, state, and local governmental agencies were used to estimate Tucson Water's projected service area population through 2050. These population projections provide a common basis for all regional planning efforts and are expected to be adopted by PAG's Regional Council in 2005. The starting point for this analysis is Census 2000. The U.S. Census Bureau provided a count of the local population for a 2000 baseline. The Arizona Department of Economic Security, in conjunction with PAG, provided a statewide projection of population for 2030 and 2050 based on historical growth trends and other planning factors. The Arizona Department of Economic Security further refined the projections to provide 2030 and 2050 projected populations for each county within the State. PAG used the projections for Pima County and worked with all local jurisdictions to provide population projections for eastern Pima County (PAG, 2003). The Pima County population projections for 2030 and 2050 are presented in Table 3-1 along with projections for the Long-Range Planning Area and Tucson Water's projected service area.

Areas	Population		
	Year 2000	Year 2030	Year 2050
Pima County	843,746 <sup>1</sup>	1,506,673 <sup>2</sup>	1,884,432 <sup>2</sup>
Long-Range Planning Area	779,684	1,405,799	1,483,649
Tucson Water Service Area	638,936 <sup>3</sup>	1,215,841 <sup>4</sup>	1,275,023 <sup>4</sup>

<sup>1</sup> U.S. Census Bureau.

<sup>2</sup> Pima Association of Governments.

<sup>3</sup> Service area in 2000.

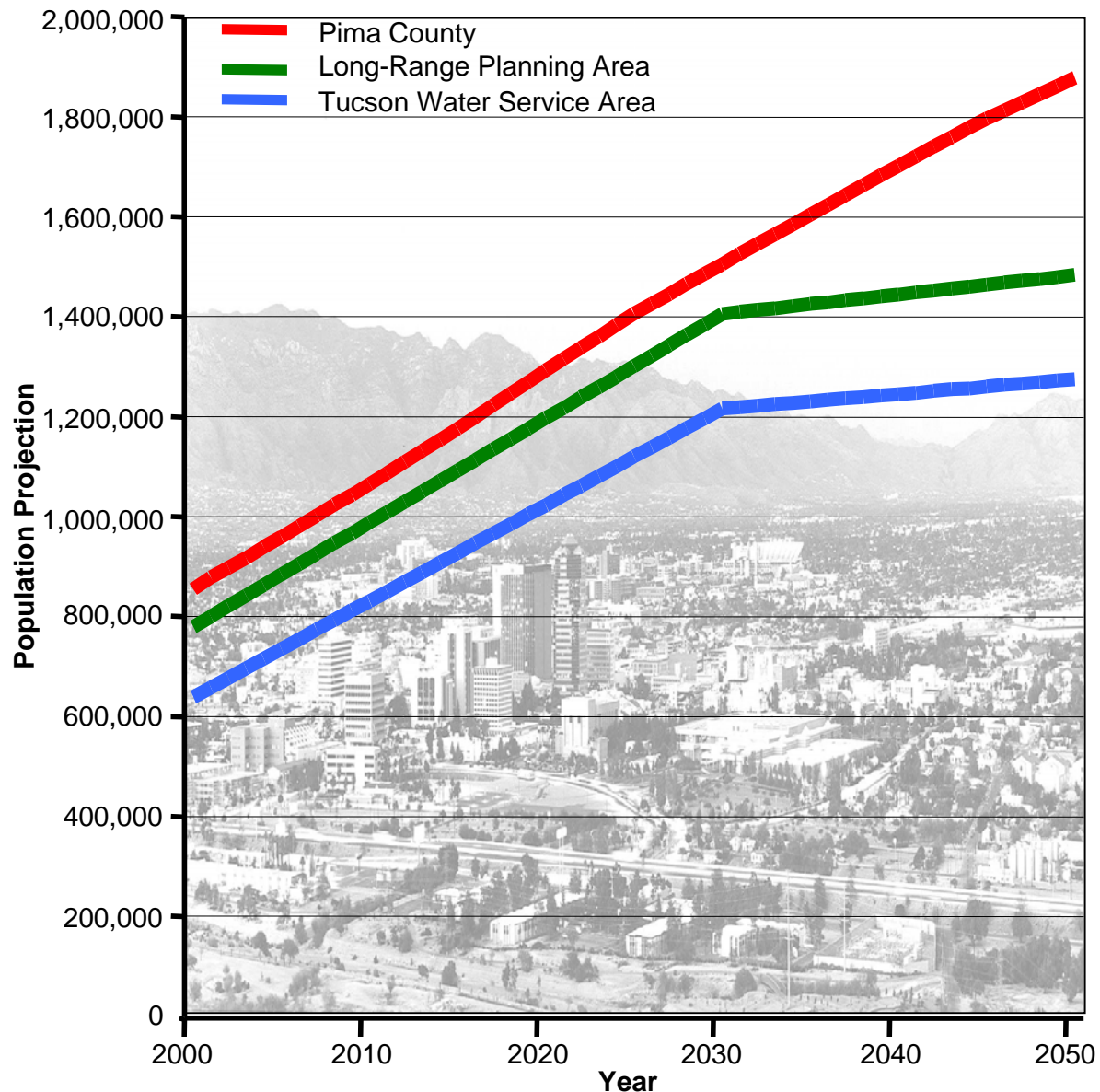
<sup>4</sup> Projected service area.

**Table 3-1:** Population Counts and Projections for *Water Plan: 2000–2050*.

PAG generated a spatially distributed population projection for eastern Pima County for 2030. This is the most detailed data set available and is derived from a transportation-based assessment of "traffic analysis zones." The 2050 projection provided by PAG did not have the same resolution since it was developed at the larger census tract level. However, the projection provided a spatially distributed population based on many of the same updated planning assumptions used in the 2030 projection.

The 2030 and 2050 population projections generated by PAG were used by Tucson Water to generate aggregated projections of population within the Long-Range Planning Area and Tucson Water's projected service area. Annual population projections were estimated by interpolating between 2000, 2030, and 2050. Annually aggregated population projections for Pima County, the Long-Range Planning Area, and the projected Tucson Water service area are shown on Figure 3-2. Review of Figure 3-2 indicates that Pima County's population is projected to increase from 843,746 in 2000 to about 1.5 million by 2030 and 1.9 million by 2050 while the Long-Range Planning Area population is projected to grow from 779,684 in 2000 to about 1.4 million in 2030 and 1.5 million by 2050. This figure also indicates that most of the future growth in Pima County is projected to occur outside of the Long-Range

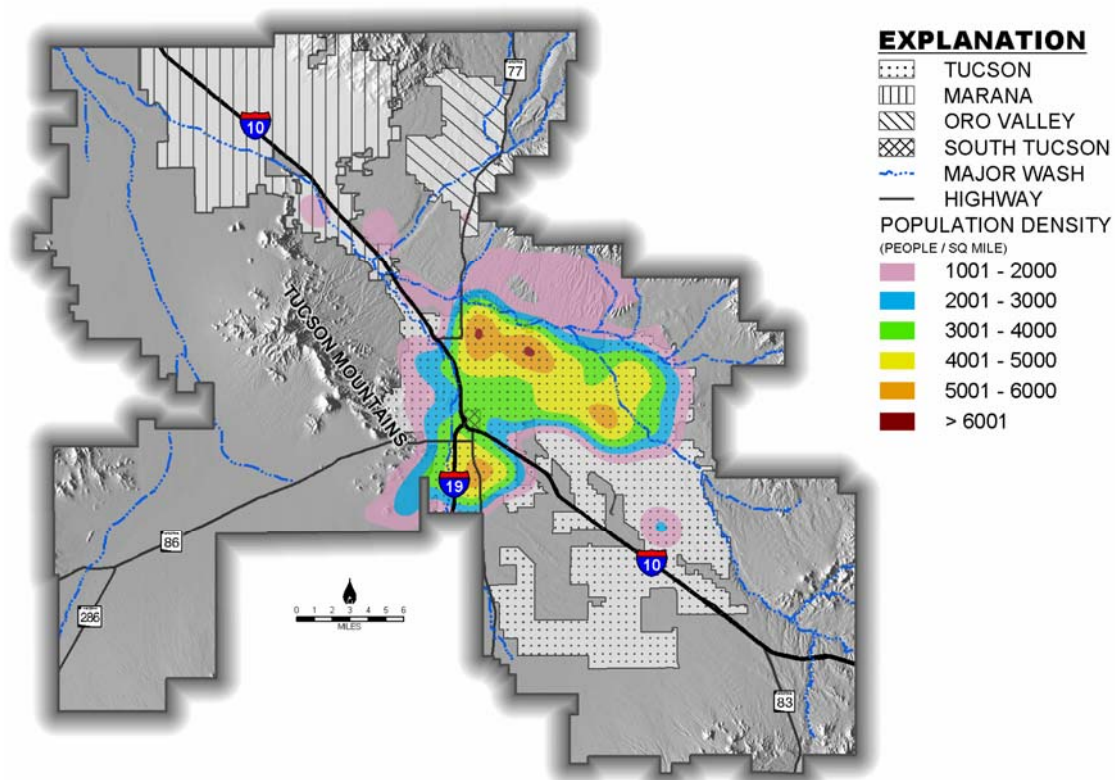
Planning Area after 2030. The population to be served by Tucson Water is projected to increase from 638,936 in 2000 to about 1.2 million in 2030 and 1.3 million in 2050.



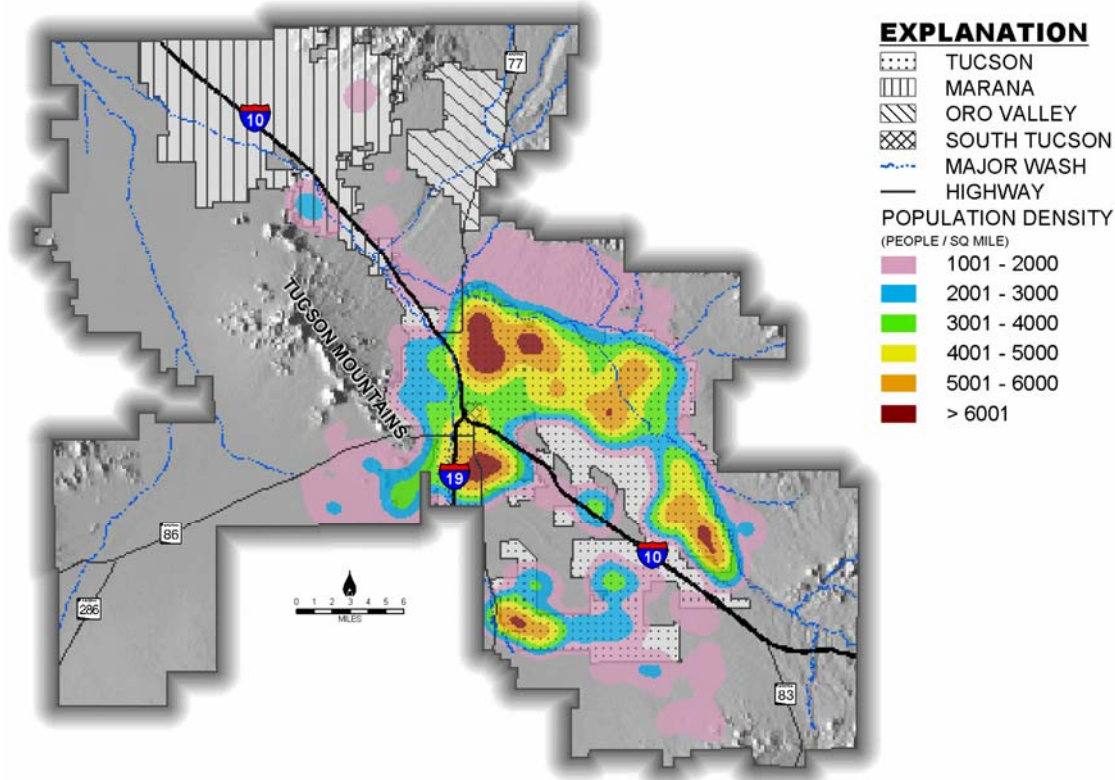
**Figure 3-2:** Population Projections from 2000 to 2050.

In addition to developing annually aggregated projections for population, the spatial distribution of Tucson Water's projected service area population was also derived through this process. Figure 3-3 shows the spatially distributed population of Tucson Water's service area in 2000 while Figure 3-4 depicts the projected population distribution of Tucson Water's service area in 2030. Review of Figures 3-3 and 3-4 indicates that over this 30-year period, significant population growth is projected to occur on the fringes of urban Tucson including the southeast part of the service area. This trend is projected to continue through 2050.





**Figure 3-3:** Tucson Water Service Area Population Distribution, 2000.



**Figure 3-4:** Tucson Water Service Area Population Distribution, 2030.

## PER CAPITA WATER USAGE RATES

In order to derive a projected total water demand from projections of population, the average amount of per capita water use must be determined. Such water usage is commonly measured in gallons per capita per day (GPCD). The total GPCD water usage rate for Tucson Water's current customer base is 177 GPCD and includes water used to supply both potable and non-potable demands. The total GPCD should not be confused with ADWR's GPCD compliance target which measures only potable per capita water use.



*Xeriscape™ at Tucson Water's Hayden-Udall Treatment Plant – An example of natural desert vegetation used to create a water-efficient desert oasis.*

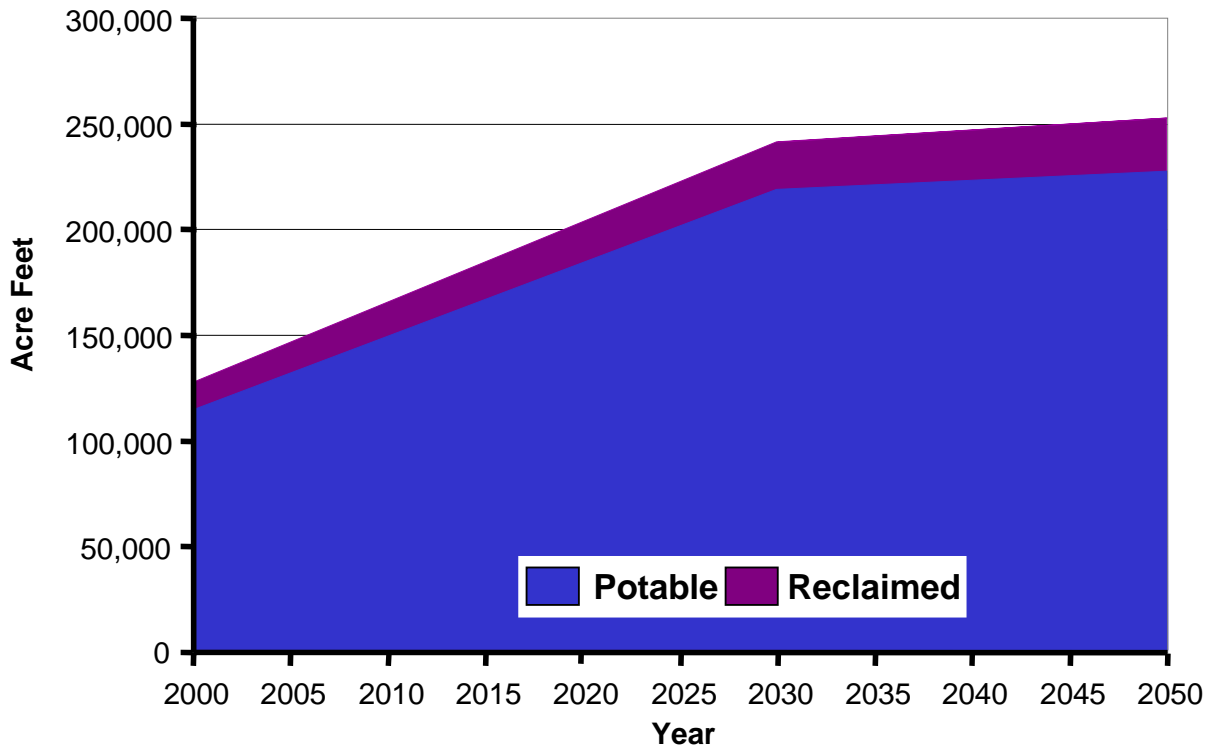
The total water usage rate of 177 GPCD includes approximately 14 GPCD of reclaimed water and 163 GPCD for all potable deliveries. Per capita potable water usage can be further broken down into total residential use at 110 GPCD (which combines single-family rates of 120 GPCD and multi-family rates of 100 GPCD), commercial and industrial water use at 35 GPCD, and lost and unaccounted for water at 18 GPCD.

The total water usage rate of 177 GPCD has been relatively consistent over the past 20 years; hence, it is conservatively assumed that it will remain constant throughout the planning period. The potential effectiveness of demand management strategies such as more aggressive conservation programming will be evaluated to determine if GPCD can be further reduced in a cost-effective manner. Once the demonstrated effects of additional demand

management initiatives are quantified, the total GPCD assumption may be revised in future planning updates. The relative contributions of reclaimed water use and potable water use are assumed to remain constant within the 50-year planning horizon even though total water use will increase over time.

## PROJECTIONS OF TOTAL WATER DEMAND

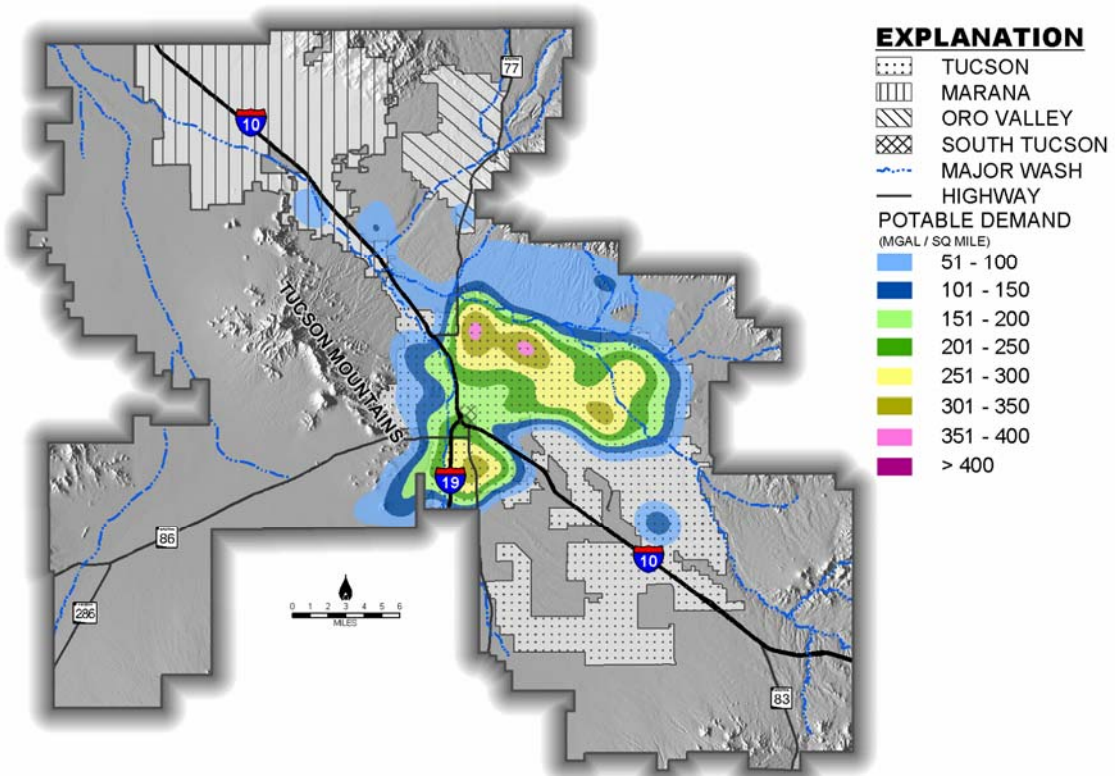
The previous sections described the basic elements used to project water demand: a defined geographic area, the current and projected annual service area population at specified points in time, and the anticipated total per capita water usage rate (i.e. total GPCD). The resulting annual total water demands from 2000 through 2050 are presented in Figure 3-5. Tucson Water's annual total demand is projected to grow from 128,521 acre-feet in 2000 to 253,000 acre-feet in 2050. The slower increase in water demand from 2030 to 2050 reflects the shift in population growth to areas outside of Tucson Water's projected service area. At least eight percent of total water demand is projected to be met with reclaimed water and the remaining 92 percent is potable demand.



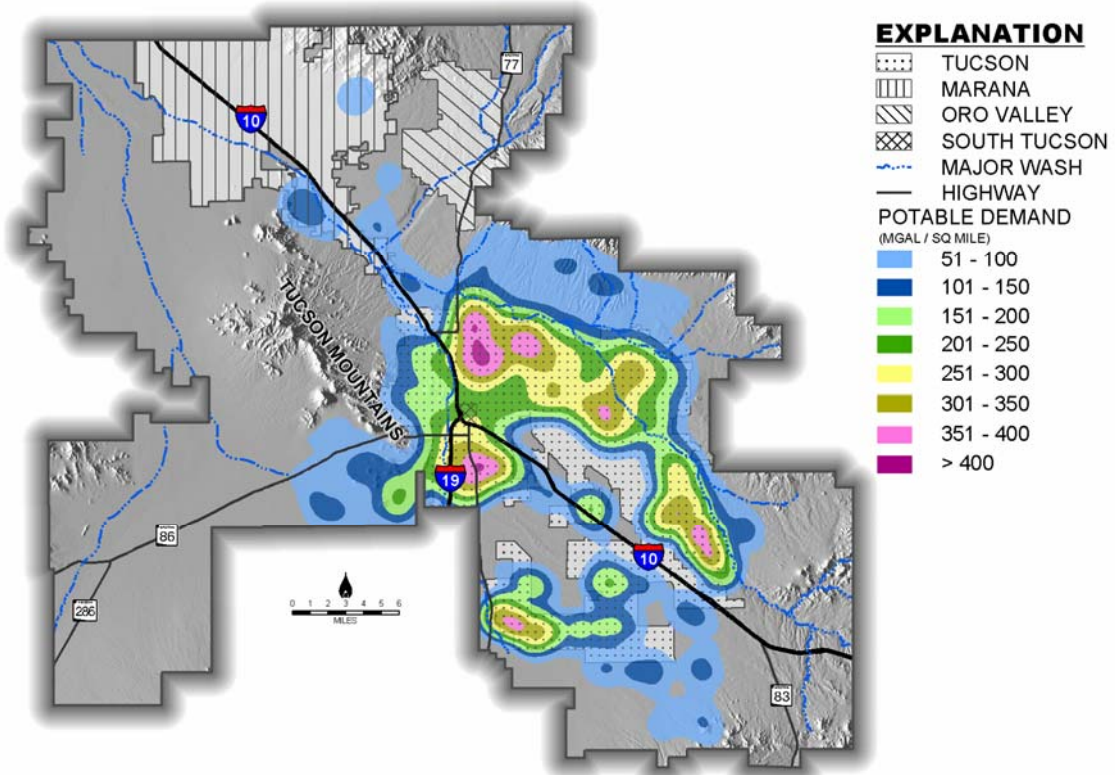
**Figure 3-5:** Tucson Water's Projected Total Annual Water Demand from 2000 to 2050.

One main goal of the current planning process is to identify sufficient water supplies to meet this projected aggregate demand curve. In addition, the spatial distribution of these demands within Tucson Water's projected service area will have a significant impact on the water system upgrades and extensions that must be made over time. The service area populations for 2000 and 2030 were used to generate spatial distributions of potable water demand as shown in Figures 3-6 and 3-7.





**Figure 3-6:** Annual Potable Water Demand for Tucson Water's Service Area, 2000.



**Figure 3-7:** Annual Projected Potable Water Demand for Tucson Water's Service Area, 2030.



Tucson Water's potable distribution system is divided into a series of "Water Service Areas" which are zones that provide uniform water pressure based on changing land surface elevations and other operational factors. The spatially distributed population projections were merged with the Utility's Water Service Areas to assign water demand to discrete areas within the projected service area. This merger yielded spatial projections of future water demand by water service area, which in turn were used to project water system improvements needed to serve future Tucson Water customers.

Future water demands can vary significantly from those projected in this planning assessment due to many factors which are discussed in the next section. While the curve shown in Figure 3-5 provides a solid foundation from which to build planning pathways to the future, the pathways must be flexible enough to accommodate the uncertainties inherent in projecting future changes in population and therefore total water demand.

## **EXTERNAL FACTORS THAT CAN AFFECT FUTURE DEMAND**

There are a number of variables that can cause water demand to change over time. Many of these variables are external factors which are beyond Tucson Water's control. Three of these factors are discussed in this section.

### **Weather**

Long-term weather patterns such as prolonged drought or a long-term warming trend could result in increased customer water use. Conversely, periods of increased rainfall can result in decreased per capita water usage. The current water-use planning assumption of 177 GPCD is based on 20 years of data. This time period was characterized by both wet and dry periods. Therefore, the per capita planning assumption used to make demand projections would be appropriate if similar variations in weather patterns continue into the future. Should there be a marked difference in future patterns resulting in a significant change in per capita water usage, then the per capita planning assumption would be revised accordingly.

### **Types of Water Use**

Changes in the amount of residential, commercial, and industrial water use within the Long-Range Planning Area could create a change in the community's total per capita water usage rate. The community could shift away from its current desert-landscape ethic toward higher water use landscapes. Some industrial processes use large quantities of water, and per capita water demand could be affected if industrial activity increased significantly in the Tucson area.

### **Population**

The total water demand projection is driven largely by the rate of population growth in the area. This factor is not under Tucson Water's control; however, it has a profound impact on the demands that must be met. The actual future growth rate will vary from what is currently

projected; therefore, the latter will need to be adjusted periodically based on revised population estimates and trends resulting from future census counts.

## DEMAND MANAGEMENT

Demand management initiatives are a critical element in any water-resource plan. The extent to which water demand can be further reduced has a significant bearing on the water resources and system improvements that will be utilized and implemented. Conservation and improving water system efficiency are two major demand management program areas.

### Conservation Programming

Water conservation programming will continue to play an important role in Tucson Water's recommended plan. Because communities differ in their mix of residential, commercial, and industrial demands, residential water use as measured by the single-family residential water usage rate provides a fairly reliable benchmark to evaluate how efficiently a given community uses water in comparison to others. Single-family residential water use was selected as the benchmark for comparison because it is less prone to skewing based on economic and other factors that are specific to each community.

Table 3-2 presents the single-family residential water usage rates for Tucson and other comparable municipalities. Tucson Water's ongoing conservation programs have been effective in maintaining a relatively low water usage rate which has been fostered and maintained for the past 20 years by a largely incentive-based conservation program and extensive educational outreach efforts. These programs will be continued and may even need to be expanded in order to avoid drifting back toward the higher per capita water usage of the past.

Single-Family Residential GPCD*	Selected Western Cities
114	El Paso, Texas
<b>120</b>	<b>Tucson, Arizona</b>
123	Mesa, Arizona
131	Glendale, Arizona
138	Albuquerque, New Mexico
140	Tempe, Arizona
165	Phoenix, Arizona
169	Scottsdale, Arizona
230	Las Vegas, Nevada
236	Oro Valley, Arizona
242	Sacramento, California
261	Fresno, California
*Source: Data provided by utility representatives except for Las Vegas and Albuquerque which were obtained from Western Resource Advocates (2003).	

**Table 3-2:** Comparison of Single-Family Residential Water Usage.

Water saved through conservation programming does not create physical water; hence, conservation is not an additional source of wet-water supply. Instead, it is an important water demand management tool that contributes toward the efficient use of all existing and future water resources.

### Tucson Water's Conservation Program – Past to Present

Conservation programming at Tucson Water grew out of early demand management initiatives. In 1903, Tucson Water “appealed to the fair-minded citizens of Tucson” to curb their lawn and garden watering during peak usage hours (Logan, 2002). Similarly, Tucson Water developed the *Beat the Peak Program* in the 1970s to reduce spikes in daily summertime water use. The program urged residents to cut back outdoor watering to every other day and not to water during the peak usage times of day. This program was initially created to provide Tucson Water time to make costly improvements to the water system. Tucson’s conservation-minded citizens embraced the program’s message so strongly that it came to include a summer water conservation education program.

From the late 1970s to present-day, Tucson Water’s conservation programs have included a number of initiatives such as:

- *Beat the Peak*.
- Rebates and incentives such as the ultra-low-flush toilet rebate program.
- Direct assistance programs such as the *Zanjeros* audit process.
- Targeted educational programs for school children, homeowners, business owners, and landscapers.
- Water-efficiency plumbing code changes and ordinances.
- Water conservation-related research projects.
- Increasing block rate structure.

The increasing block rate structure for residential customers is based on water use where the more water a household uses in a given month, the more expensive the water becomes. Commercial and industrial customers operate on a different rate structure which has additional charges for any water used over that particular customer’s “base use” during the winter months.

Ordinances that require water-efficient plumbing fixtures, low water-use landscapes, or that prohibit water waste have been implemented in both the City of Tucson and Pima County. These ordinances have played a key role in managing water use over the past 15 to 20 years.



***Beat the Peak*** – This conservation program spans three decades.



A more detailed discussion on conservation programming is provided in Appendix B: *Demand Management Program Development*.

### Tucson Water's Conservation Program – Future

The current level of conservation programming will continue in order to maintain the per capita water usage rate. Tucson Water will also continue to evaluate existing programs and consider developing others based on program effectiveness, reliability, and cost.

Based on the experience of Tucson Water and conservation program industry experts, a conservation program that would achieve savings above what has already been accomplished would need programs with a mandatory and technological emphasis as opposed to the more voluntary programs and those that seek a change in customer behavior. Mandatory initiatives could include requiring water-saving retrofits of homes upon resale of the property, more aggressive water pricing structures, abolition of certain water uses, and/or mandatory conservation requirements on new and existing developments.

Before recommending more aggressive measures, Tucson Water will evaluate their demonstrated effectiveness in other comparable communities and consider their potential applicability in the Tucson community. Implementation of more aggressive programs would require firm resolve on the part of the community and governing bodies. Such efforts could result in additional decreases in the total GPCD for the community and a corresponding decrease in the projected growth of total water demand in future years.

### **Water System Efficiency**

Another area in which Tucson Water can exert some control on water demand is by improving the efficiency of its water distribution system by reducing lost and unaccounted for water. The need to more stringently manage water supplies is causing changes in the way utilities are regulated. ADWR has begun statewide enforcement of rules that obligate municipal providers to maintain lost and unaccounted for water at an amount not to exceed 10 percent of total water production. This provides added incentives to water providers to more efficiently manage their systems.

Water losses can be reduced by implementing a cohesive strategy to improve system efficiency. Leak detection and pressure management are maintenance programs which monitor potential water losses. A meter replacement program has been instituted to ensure that older meters that tend to under-report water use are replaced. Tucson Water is presently planning and implementing measures to reduce the amount of water lost through leaks, inaccurate metering, accounting, theft, and other losses. Decreases in the amount of water that is lost will help offset increasing total water demand.

### **THE ROLE OF PROJECTED DEMAND IN WATER PLANNING**

The projection of water demand through 2050 provides a series of supply targets that must be met in the years to come. To meet these targets, Tucson Water will ensure that sufficient

water resources will be available and effective demand management measures will be implemented. Where supply shortfalls are anticipated within the planning period, additional sources of supply will need to be acquired to satisfy any unmet projected need. More aggressive demand management programs may also be required. Finally, the spatial distribution of projected water demands will guide water system upgrades and expansions needed to convey water from its sources to where it will be needed in future years.